Title: A seed tape including successively arranged germinating units.

Technical Field

The invention relates to a seed tape including successively arranged germinating units, and which further includes at least one carrier strip as well at least one auxiliary layer of biodegradable, flexible, non-woven or film-like material arranged on said carrier strip, whereby the auxiliary layer is optionally locally interrupted a short distance along the seed tape, and whereby each germinating unit includes a mixture of granulated carrier and at least one granulated additive and optionally an adjuvant in addition to one or more seeds, said mixture plus the seed(s) being kept together to form at least one core portion in the germinating unit, as well as whereby said seed tape can optionally be cut into separate germinating units prior to the irrigation and/or the bedding out.

Background Art

The term "carrier" is here to be construed as a material including at least one of the substances: granulated expanded vermiculite, perlite, zeolite, cellulose materials, such as wood fibres and sphagnum, burned clay, rock wool or the like substances, whereby it is possible to obtain a desired degree of water conveying capacity, ion exchanging properties etc.

The term "additive" is here primarily to be construed as water-absorbing materials, such as superabsorbing materials, i.e. absorption of H_2O in order to achieve a moisture buffer, such as for instance superabsorbing polymers (SAP).

The expression "adjuvant" should here be understood so as to cover one or more substances selected among plant nutrients, plant protectants, such as pesticides, including herbicides, insecticides, especially systemic insecticides, fungicides, virae, cultures of bacteria, cultures of fungi, such as Trikoderma, fungus spores, microen-

capsulated fungicides, eggs from useful insects, such as predatory nematodes, fertilizers, enzymes, animal repellents, hormones, pH-adjusting agents, activated carbon, clay particles, trace elements, such as molybdenum, wood fibres or wood powder, kieselguhr, surfactants or other substances with a favourable effect on the germination and the growth of plants, where several substances are available in microencapsulated form.

The expression "biodegradable" material is here to be construed as a material gradually disintegrating and/or being part of the ordinary biological food chain within a measurable period when left alone in its natural state.

The handling of seed tapes is often encumbered with the problem that the carrier, the additives and the possible adjuvants have a tendency to sift out of the individual germinating units, viz. the pockets, which presents a rather disadvantageous feature because a careful control of the pesticides inserted, such as for instance Gaucho, is desired. In addition, extra care should be taken that the materials being inserted in the germinating units remain in the initial locations because the manufacturing of such seed tapes must be carried out at a very high speed, viz. several hundred m/min.

Disclosure of Invention

The object of the invention is to provide a seed tape of the above type which ensures a particularly reliable retention of the carrier, the additives and the possible adjuvant in each germinating unit.

The seed tape according to the invention is characterised in that the core portion made of the above mixture includes locally adhered bicomponent fibres of one or more thermoplastic materials which form a coherent, open network for keeping the granules of the mixture and possibly also one or more seeds together. As a result, the carrier, the additives, i.e. in particular pesticides and possible adjuvants are efficiently retained in the network whereby the sifting tendency has been minimized. In

this manner the seed tape is suited for a very high-speed manufacturing procedure optionally involving significant stress loads caused by strong accelerations/decelerations of the tape.

According to the invention, the thermoplastic material(s) of the bicomponent fibres may be biodegradable with the result that the seed tape is particularly environmentally friendly.

Moreover, the bicomponent fibres forming the network may according to the invention be of the coaxial type where the outer component of the fibre presents a lower melting point than the inner component of the fibre, preferably in such a manner that the outer component presents a melting point of approximately 110 to 130°C and the inner component presents a melting point of approximately 160 to 300°C. Such a type turned out to provide a particularly reliable network.

According to the invention the seed may be placed in an incision in the core portion, said incision preferably being of a depth of 25 to 50%, especially 33 to 40% of the thickness of said core portion. In this manner the seed is well protected inside the core portion.

Moreover, the outer component of each bicomponent fibre may according to the invention be made of polylactide (derived from lactic acid) (PLA) having a relatively low melting point, whereas the inner component of said fibre may be made of polylactide (derived from lactic acid) (PLA) having a relatively high melting point. The resulting network is particularly reliable and biodegradable.

According to the invention one component of each bicomponent fibre may for instance be made of polyester (PET) or polyethylene (PE) having a relatively low melting point, whereas the other component of said fibre may be made of polypropylene (PP) having a comparatively higher melting point. These substances turned out to be particularly suited materials for the network.

In addition, each bicomponent fibre may according to the invention be of a length of 0.1 to 6.5 mm, preferably 0.2 to 3.5 mm, especially 1 to 2 mm, and a fineness of 1 to 5 Decitex, preferably 3 Decitex, which turned out to be particularly advantageous.

According to the invention the incision may form an angle of 40 to 65°, such as 45 to 55°, with the longitudinal axis of the seed tape, which turned out to be particularly advantageous.

Furthermore, the incision may according to the invention be substantially Z-shaped with the result that it is particularly easy to insert the seed into the core portion.

According to the invention the carrier strip may be made of a biodegradable material, such as paper, preferably paper of a weight of 20 to 50, especially 25 to 35 g/m^2, and optionally be permeable to gas.

According to the invention the auxiliary layer may be permeable to gas and for instance be made of thin paper, which turned out to be a particularly advantageous material.

Moreover according to the invention, the carrier may be a granulated vermiculite, where less than 2% of the vermiculite are of a grain size of up to 0.4 mm and the remaining percentages are of a grain size of 0.25 to 4 mm, or the carrier may be a Leca-like material (Leca is a registered Trade Mark) or a fibre-like material, such as stone or mineral wool fibres or cellulose fibres, in particular coarse cellulose fibres, and the additive may include a superabsorbing polymer (SAP) in form of a polymer based on starch or cellulose or acrylate. The core portions of the seed tape turned out to work particularly well in connection with such a carrier and such an additive.

According to the invention, the carrier strip and/or the auxiliary layer may be made of a thermoplastic material, such as polypropylene or polylactide (derived from lac-

tic acid) (PLA), said material preferably being of a weight of 15 to 30 g/m^2, especially 18 to 22 g/m^2, in particular 20 g/m^2. Such a material turned out to be particularly advantageous.

Moreover it is according to the invention rendered possible that the core portion including the bicomponent fibres is fastened to the carrier strip and/or the auxiliary layer by using the adhesiveness of said bicomponent fibres and/or by means of glue. The resulting fastening of the core portion to the carrier strip and/or the auxiliary layer is particularly reliable.

Moreover, the auxiliary layer may according to the invention be a glue layer which on the outer side covers the core portion, whereby a particularly simple embodiment of the seed tape is obtained.

According to the invention the bicomponent fibres of polylactide (derived from lactic acid) (PLA) may form 4 to 9, especially 7 to 8% by weight of the mixture, whereas the superabsorbing polymer (SAP) may form 1 to 7% by weight, especially approximately 2.5% by weight of the mixture, and the rest may for instance be vermiculite or wooden dust. As a result, the core portion achieves a particularly good grip about the SAP granules.

In addition according to the invention, at least the mixture including the bicomponent fibres may have been subjected to a short heating to no more than approximately 125°C, such as by means of ultrasound or hot air before it is inserted in the seed tape with the result that the completed core portion is provided with a particularly good cohesive force.

According to the invention the bicomponent fibres of the core portion and optionally also the carrier, the additive and the adjuvant, if any, may have been placed on the carrier strip by means of air. The resulting core portion is provided in a particularly simple way.

Furthermore, each core portion including the bicomponent fibres may according to the invention be provided by heating a mixture of bicomponent fibres, carrier, additive and adjuvant, if any, and followed by a cooling thereof so as to form a "rod", each core portion then being cut off said "rod". In this manner the seed tape is particularly inexpensive to manufacture.

According to the invention, the seed(s) or the granules of the mixture may have been placed on the carrier strip or in the core portion by said seed(s) or granules being magnetized through a coating and thereby being attracted to the carrier strip or the core portion by means of small lumps or stripes of permanent-magnet-powder, such as strontium-barium-ferrite powder, optionally titanium dioxide and barium ferrite powder, arranged on said carrier strip or on said core portion. In this manner a particularly reliable placing of the seed(s) or the granules in the seed tape is obtained.

Furthermore, the coating used on the seed(s) or the granules may according to the invention include starch, such as paste, or polymers as well as magnetic powder in form of iron powder for instance of a grain size of 17 to 23 μm, especially 20 μm, plus possible insecticides, fungicides or other adjuvants. The resulting positioning of the seeds or the granules in the seed tape is particularly accurate.

In addition, the carrier may according to the invention have been microencapsulated before it is placed in the core portion with the result that these substances are particularly well controlled.

Moreover according to the invention, the length of the core portion including the bicomponent fibres may be smaller than the width of the carrier strip, said length preferably being maximum 80% of said width. In this manner it is additionally ensured that possible granules with pesticides do not accidentally sift out of the seed tape.

Furthermore according to the invention the bicomponent fibres and/or the carrier strip and/or the auxiliary layer may be made of a polymer based on starch, cellulose or acrylate with the result that a particularly good biodegradability is obtained.

In addition, when the carrier strip is made of paper and a second carrier strip is made of PLA and an auxiliary layer is made of paper or PLA, then the seed tape may according to the invention be characterised in that the auxiliary layer is secured to the PLA carrier strip by means of a pressure-sensitive or heat-sensitive glue, which has been applied onto the auxiliary layer preferably in advance. In this manner the seed tape can be manufactured in a particularly easy and fast manner.

According to the invention the individual germinating units may be separated by means of at least one perforated line, preferably two relatively closely arranged perforated lines. As a result, the seed tape zigzag-packed in a germinating container folds automatically in a controlled manner because the seed tape is particularly ready to be bent along the perforated lines. The perforated lines ensure an exact separation of the germinating units in connection with a fully automated machinery bedding out.

In addition, each core portion may according to the invention include a recess in which one or more seeds is/are placed, said seed(s) being retained by means of glue or magnetic particles. In this manner each seed is ensured an accurate placing in the tape which is a vital factor in connection with a fully automated machinery bedding out.

Moreover, the seed tape may in the areas outside the core portions present a thickness of 6 to 15 mm, preferably 7 to 9 mm. As a result the seed tape with the materials, plants and plant roots placed therein can pass the advancing and separating mechanism of a bedding out machine without being damaged, said mechanism including two sets of advancing wheels, where the second set of wheels rotate at a higher speed than the first set of wheels in such a manner that the structure and con-

tent of plant roots of each germinating unit remain intact although said germinating units are partially separated in the advancing and separating mechanism.

Finally, the invention relates to a web to be cut into juxtaposed seed tapes, said web including a carrier strip of PLA and an auxiliary strip of paper before it is subjected to the cutting procedure, and where a row of core portions are provided between said strips, said web being characterised in that the carrier strip and the auxiliary strip with the core portions therebetween are such that the auxiliary strip includes at least one longitudinal rim area parallel to longitudinal edges of the carrier strip and projecting beyond at least one of said edges, whereby at least one marker opening is shaped in said rim area opposite each row of core portions, said marker opening preferably being square and produced by way of punching. The resulting manufacture of the seed tape according to the invention is particularly easy because said seed tape can be produced by cutting said web into tapes.

Brief Description of the Drawings

The invention is explained in greater detail below with reference to the accompanying drawings, in which

Fig. 1 is a perspective view of a portion of an embodiment of the seed tape according to the invention,

Fig. 2 is a perspective view of a core portion,

Fig. 3 is an enlarged view of a portion of the bicomponent fibres of the network,

Fig. 4 is a perspective view of a bicomponent fibre, where said bicomponent fibre is of the coaxial type,

Fig. 5 is a perspective view of a bicomponent fibre, where the two components of the fibre are juxtaposed,

Fig. 6 is a perspective view of a core portion, where an inclined incision in said core portion appears particularly clearly,

Fig. 7 illustrates a second embodiment of the seed tape according to the invention, where the length of each core portion is smaller than the width of the carrier strip of the seed tape, and

Fig. 8 is a perspective view of a web to be cut into juxtaposed seed tapes.

Best Mode for Carrying out the Invention

The seed tape of Fig. 1 includes many successively arranged germinating units, only the first three germinating units being designated a reference numeral, viz. 1a, 1b and 1c. As illustrated, the seed tape includes at least one carrier strip 3 as well as at least one auxiliary layer 5 of biodegradable, flexible, non-woven or film-like material and being placed on said carrier strip. The auxiliary layer 5 can be locally interrupted over a short distance along the seed tape, which, however, has not been illustrated. The carrier strip 3 and the auxiliary layer 5 can optionally be locally joined by means of transverse glue zones, one end of such a glue zone being indicated at 4.

In addition to one or more seeds 7, each germinating unit 1a, 1b, 1c includes a mixture of granulated carrier, at least a granulated additive and optionally an adjuvant, cf. the previous definition of said substances. The mixture is kept together to form a core portion 8 in each germinating unit.

Ordinarily the seed tape is in form of one long tape during the drenching so as to allow the seeds to germinate and/or be bedded out, but nothing prevents the seed tape from being cut into separate germinating units prior to the drenching and/or the bed-

ding out. The core portion 8 includes the above mixture 6 as well as locally glued bicomponent fibres of one or more thermoplastic materials 8 which together form a coherent open network, cf. in particular at 8a. The network surrounds the granules 6a of the mixture 6 in such a manner that said granules are retained in a specific position relative to the seed(s) 7. In addition, the network assists in maintaining the optimum water-air-balance about the seed, said balance usually corresponding to 75% of water and 25% of air for most types of seeds with the result that various gases can easily reach the seed and that detrimental gas, such as ethylene, can leave the seed and the adjacent surroundings before the germinating seed suffers from a detrimental effect.

The thermoplastic material(s) of the bicomponent fibres 8a can be biodegradable.

Fig. 4 illustrates how a bicomponent fibre 18 forming the network can be of the coaxial type where the outer component 18a of the fibre presents a lower melting point than the inner component 18b, preferably in such a manner that the outer component presents a melting point of approximately 110 to 130°C and the inner component presents a melting point of approximately 160 to 300°C.

It should be noted that usually the seed(s) 7 is/are not inserted in the core portion 8 from the beginning because usually they cannot tolerate the temperatures to which said core portion must be heated in order to make the bicomponent fibres stick together.

As illustrated in Fig. 2, one or more seeds can be inserted in an incision 10 in the core portion 8. The incision 10 presents preferably a depth d of 25 to 50%, especially 33 to 40% of the thickness t of the core portion 8.

Concerning the materials of the bicomponent fibres it should be noted that the outer component 18a of each fibre can for instance be made of polylactide (derived from lactic acid) (PLA) having a relatively low melting point whereas the inner compo-

nent 18b of said fibre can be made of polylactide (derived from lactic acid) (PLA) having a relatively high melting point.

It is also possible that the first component 18a of each bicomponent fibre can be made of polyethylene (PE) having a relatively low melting point, whereas the other component 28b of said fibre can be made of polypropylene (PP) or polyester (PET) having a comparatively higher melting point.

Each bicomponent fibre can be of a length of 0.1 to 6.5 mm, preferably 0.2 to 3.5 mm, especially 1 to 2 mm, and a fineness of 1 to 5 Decitex, preferably 3 Decitex.

As shown in Fig. 6, the incision 10 can form an angle v of 40 to 65°, such as 45 to 55°, with the longitudinal axis A of the seed tape.

As shown in Fig. 2, the incision 10 can be substantially Z-shaped.

The carrier strip 3 can be made of a biodegradable material, such as paper, preferably paper of a weight of 20 to 50, especially 25 to 35 g/m^2, and optionally be permeable to gas and for instance be made of thin paper.

As far as the carrier and the additive of the core portion 8 are concerned, said carrier can be a granulated water-absorbing material, such as vermiculite, where less than 2% of the vermiculite are of a grain size of up to 0.4 mm and the remaining percentages are of a grain size of 0.25 to 4 mm, or the carrier can be a Leca-like material (Leca is a registered Trade Mark) or a fibre-like material, such as stone or mineral wool fibres or cellulose fibres, in particular coarse cellulose fibres, whereas the additive can include a superabsorbing polymer (SAP) in form of a polymer based on starch or cellulose or acrylate.

The carrier strip 3 and/or the auxiliary layer 5 can be made of a thermoplastic material, such as polypropylene or polylactide (derived from lactic acid) (PLA), prefera-

bly of a weight of 15 to 30 g/m^2, especially 18 to 22 g/m^2, in particular 20 g/m^2. The core portion 8 can be secured to the carrier strip 3 and/or the auxiliary layer 5 by using the adhesiveness of the bicomponent fibres 18 and/or by means of an adhesive.

According to a particularly simple embodiment of the seed tape, the auxiliary layer 5 is per se formed by a glue layer, which on the outer side covers the core portion 8; said embodiment not being shown, however.

As far as the composition of the core portion is concerned it should be noted that the bicomponent fibres of polylactide (derived from lactic acid) (PLA) can form 4 to 9, especially 7 to 8% by weight of the above mixture 6, and the superabsorbing polymer (SAP) can form 1 to 7% by weight, especially 2.5% by weight of the mixture, whereas the remaining portion can be vermiculite or wooden dust.

Concerning the manufacture of the core portion 8 forming part of the seed tape, it should be noted that said core portion is made of a mixture which 6 includes bicomponent fibres 18 and can have been heated to maximum approximately 125°C, such as by way of ultrasound or hot air, with the result that one component of the bicomponent fibre can be melted without the other fibre component being melted.

The bicomponent fibres 18 of the core portion 8 and optionally also the carrier, the additive and the adjuvant can be laid down on the carrier strip by means of air, which has not been illustrated.

Each core portion 8 can be provided by heating a mixture of bicomponent fibres 18, carrier, additive and adjuvant, where said mixture has then been cooled to form a "rod" not shown and from which each core portion 8 can be cut off. As a result, the seed tape can be manufactured at a particularly low price.

The seed(s) 7 as well as the granules 6a of the above mixture can be laid down on the carrier strip 3 or in the core portion 8 by said seed 7 or granules 6a being mag-

netized through a coating and thereby being attracted to the carrier strip 3 or the core portion 8 by means of small lumps or stripes of magnetic powder, in form of a strontium-barium-ferrite powder, optionally titanium dioxide and barium ferrite powder, arranged on said carrier strip 3 or on said core portion 8.

The coating used on the seed(s) or the granules can include starch, such as paste, or polymers as well as a magnetic powder in form of iron powder for instance of a grain size of 17 to 23 μm, especially 20 μm, plus possible insecticides, fungicides and other adjuvants.

The carrier has optionally been microencapsulated before it is inserted in the core portion 8.

As illustrated in Fig. 7, the length a of the bicomponent fibre including the core portion 8 can be smaller than the width b of the carrier strip 23. The length a of the core portion is preferably maximum 80% of the width b of the carrier strip.

The invention may be modified in many ways without thereby deviating from the scope of the invention. Thus nothing prevents the seed tape from including two carrier strips 3 instead of one carrier strip 3 of PLA and an auxiliary layer 5 of PLA. One of these two carrier strips can for instance be made of PLA and two auxiliary layers 5 where one layer is made for instance of PLA and the other layer is made of for instance paper, and the other carrier strip can for instance be made of paper.

Correspondingly, the bicomponent fibres 18 and/or the carrier strip 3 and/or the auxiliary layer 6 can be made of a polymer based on starch, cellulose or acrylate.

Nothing prevents the carrier strip 3 from being made of a biodegradable, flexible, non-woven or film-like material.

The above magnetic lumps and stripes on the carrier strip or the core portion can also be used as markers for marking the exact position of the core portions in connection with the production of the seed tape.

In the seed tape according to the invention, the carrier strip 3 can for instance be made of paper, a second carrier strip not shown can be made of PLA and an auxiliary layer 5 can be made of paper or PLA. The auxiliary layer 5 can be secured to the PLA carrier strip by means of a pressure-sensitive or heat-sensitive glue which has been applied onto said auxiliary layer 5 preferably in advance.

The individual germinating units 1a, 1b, 1c can be separated by means of at least one perforated line 4, preferably two relatively closely arranged perforated lines.

Each core portion 8 can include a recess in which one or more seeds is/are placed, where said seed(s) can be retained by means of glue or magnetic particles.

In the areas outside the core portions 8, the seed tape can present a thickness of 6 to 15 mm, preferably 7 to 9 mm.

A web to be cut into juxtaposed seed tapes 1a, 1b, 1c can include a carrier strip 30 of PLA and an auxiliary strip 50 of paper before it is subjected to the cutting procedure, a row of core portions 8 being provided between said strips. The carrier strip 30 and the auxiliary strip 50 with the core portions 8 therebetween are such that the auxiliary strip 50 includes at least one longitudinal rim area 20 parallel to longitudinal edges of the carrier strip and projecting beyond at least one of said edges. At least one marker opening 52 can be shaped in the rim area opposite each row of core portions 8, said marker opening preferably being square and produced by way of punching.